



DOS DESIGN BUILD

Arch 497C

Final Presentation

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Agenda

- Site Familiarization
- System Introduction
- Building Walk-through
- Site Walk-through
- BIM-Ex / IPD

- Increase effectiveness of design across disciplines
- Increase effectiveness of sustainable goals
- Utilize clash detection to find conflicts between systems
- Accurate 3D model record for owner
- Identify concerns with phasing on campus
- Review design process
- Quickly assess cost associated with design changes

Concept

Learning Techniques

- Visual Guidance
- Primary Shapes
- Primary Colors

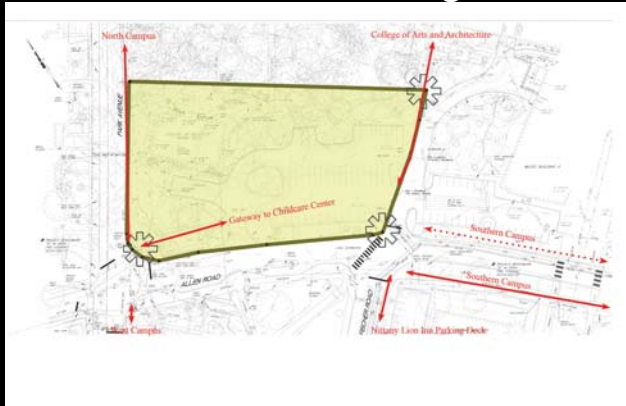


Design Concept

- Ecological Preservation
- Blending Natural Boundaries



Master Planning



- Site Planning
 - Building Orientation
- Site Circulation
 - Creating a Gateway to Northern Campus
- Ecological Preservation
 - Preserving Hort Woods
 - Lowering the impact on existing hydrology



Site Approach



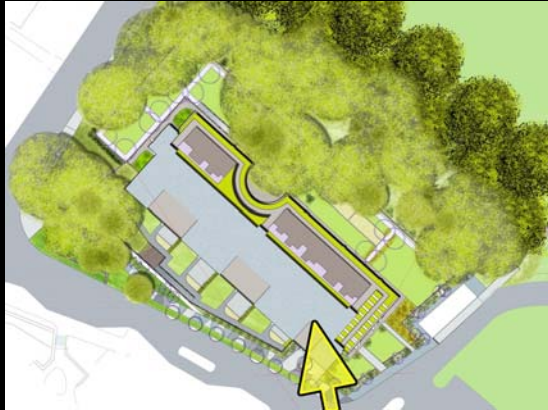
- Approach From Park Ave.
- Highlighting Nature and Hiding the Building
- Ecological Preservation
 - Preserving existing plants
 - Additional rain gardens to infiltrate water
 - Native plant selection

Allen Street Along Childcare Facility



Exterior Play Area

- Elevated Toddler Playground Area
- Split Sidewalk to create different experiences
- Architectural connections
 - Building Orientation
 - Material Connections



Entrance



Exterior Materials

- Brick
- Aluminum Curtain Wall
- Glass
- Aluminum Screen
- Copper Roof Cladding

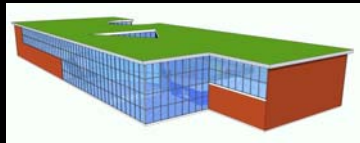


Program

■ Infant / Toddler Classroom ■ Staff / Support Space ■ Circulation ■ Preschool Classroom



Presentation 2



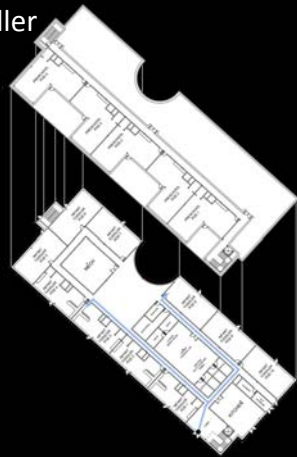
Presentation 3

As Designed Program Analysis

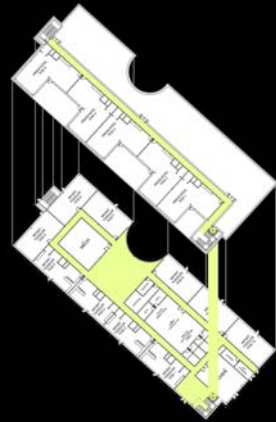
- Infant / Toddler space: + 604 sq.ft.
- Preschool space: + 590 sq.ft.
- Staff / Support Space: + 524 sq.ft.
- Circulation: < 20% of building sq.ft.



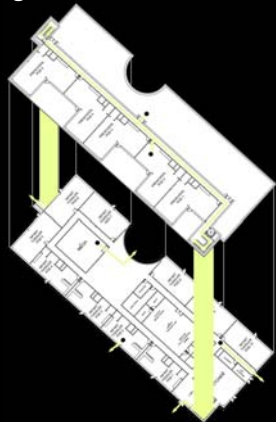
Infant / Toddler
Circulation



Accessible Circulation

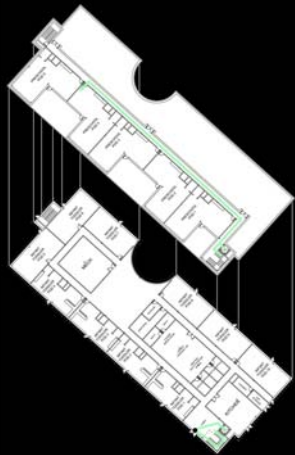


Egress Circulation

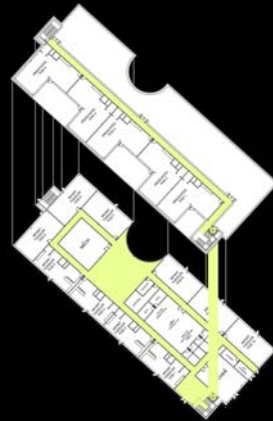




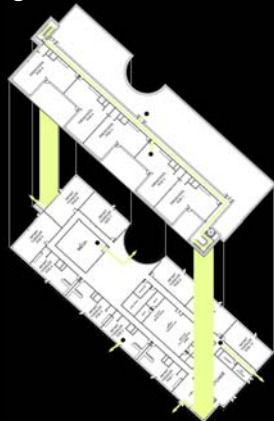
Preschool
Circulation



Accessible Circulation

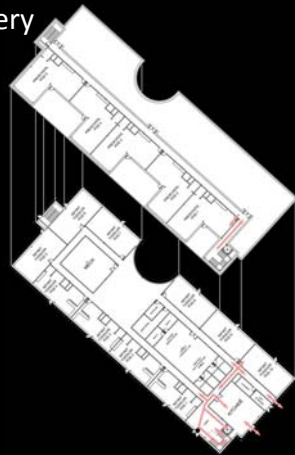


Egress Circulation

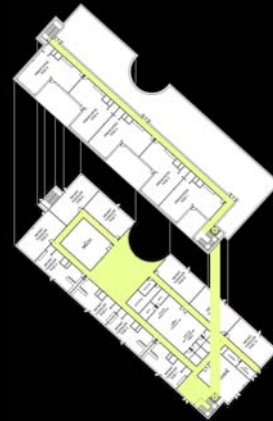




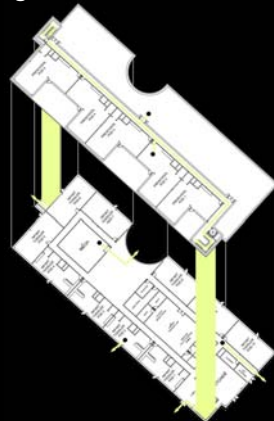
Food / Delivery
Circulation



Accessible Circulation



Egress Circulation



Systems:

Material - Steel

1st Story

Floor System: 12" Concrete Slab

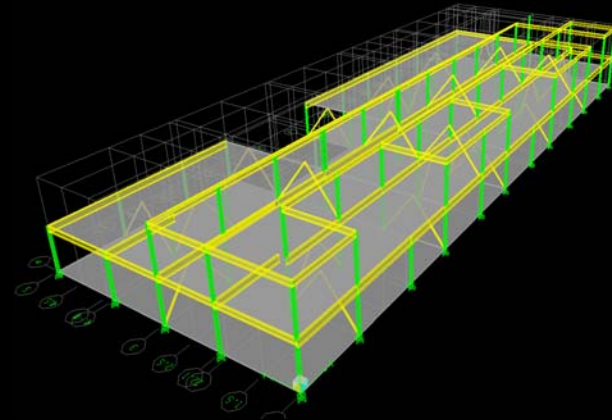
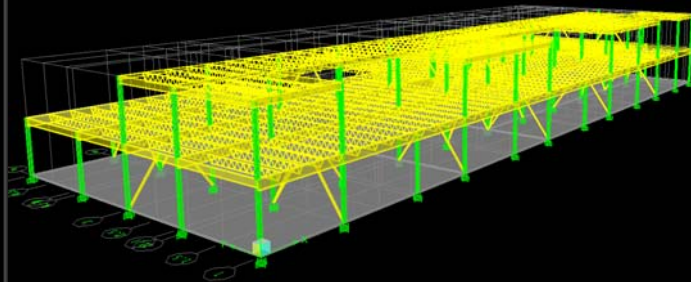
Ceiling System: Metal Deck on Joists

2nd Story

Floor System: 4.5" Concrete Slab on Metal Deck

Outdoor Floor System: Composite Rubber and Green Roof

Structural Overview



Mechanical System Design

Summer

Ventilation: DOAS (Dedicated Outdoor Air System)
Sensible: Fan Coil

- Outside Air Flow: 9616 cfm
- Peak Cooling Load: 48 Ton



Winter

Ventilation: DOAS (Dedicated Outdoor Air System)
Sensible: Radiant Floor

- Outside Air Flow: 9616 cfm
- Peak Heating Load: 539 MBh



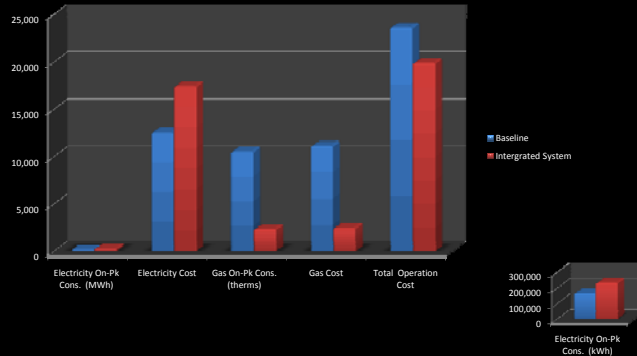
Mechanical Equipment:

- (1) EPC Air Handling Unit
- (3) Alpine ALP 285 Condensing Boiler (N+1)
- (2) Pump
- (2) Fan Coil units in most of the rooms

System Design Integration

Duct Size: Max. 14x14

Mechanical System Comparison



Baseline:

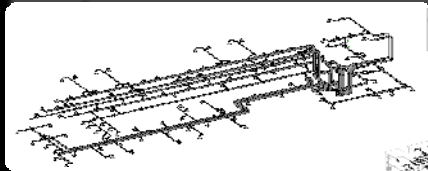
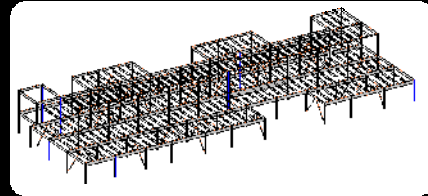
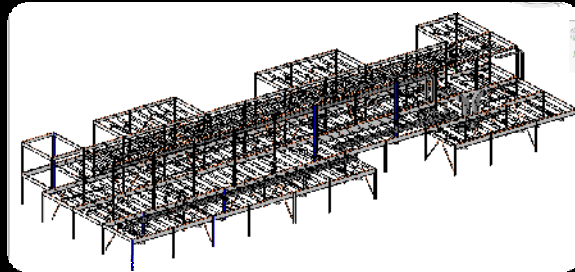
Constant volume packaged rooftop air conditioner

Integrated System :

DOAS+ Fan Coil (cooling) + Radiant Floor (heating)

20% Energy and Cost Saving

Mechanical and Structural Integration



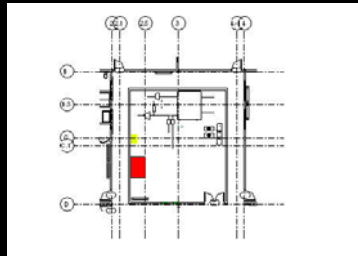
- Electrical Requirements
 - 225 kVA Transformer
 - 480V and 208V Loads
 - 480V to 208V Transformer
 - 480V and 208V Panel boards
 - Campus Backup Power Transformer
 - UPS System On-site
- Easy Access
 - Needed for Transformer Replacement

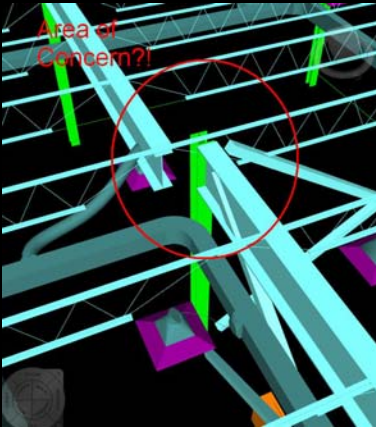
Electrical

- Light Power Density $\sim 1.2 \text{ W/ft}^2$ for Classrooms
 - Requires about 25kW of power
 - ASHRAE 90.1 2004 standard
- Building estimate $\sim 10 \text{ VA/ftft}^2$
 - Requires about 200 kVA
 - NEC 220 estimation
- Campus connection $\sim 13 \text{ kV}$

As Designed
 1.01 W/ft^2

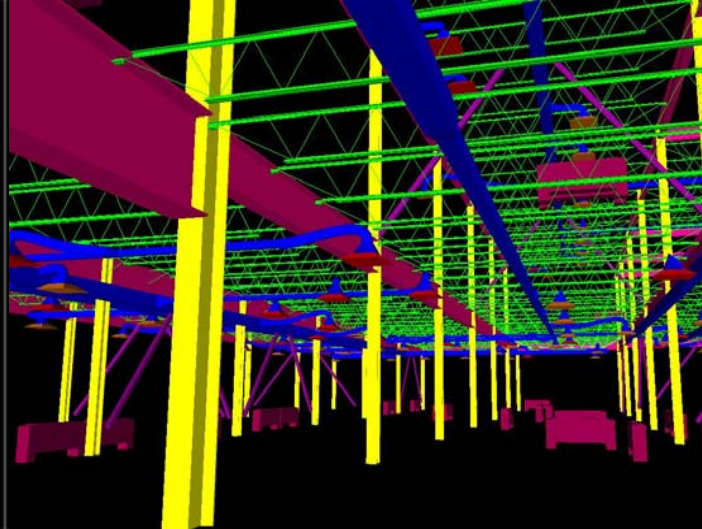
- Clearances
 - Panelboards – 3 ft
 - Transformers
 - Main – 4 ft
 - 208V to 480V - 3 ft





Coordination

- Began with over 2000 Clashes
 - Exporting Issues
- Now at 12 Clashes
- Flex Duct Clashes Still Remain
- Structural Bracing Options Exercised
- Different Mechanical Duct Sizes Looked Into



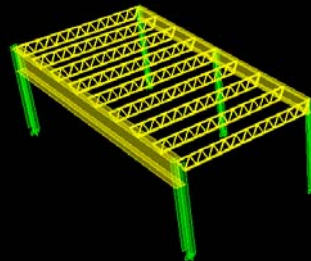


Motor-Skills Play Area



Large gross motor skills space facing out into Hort Woods.

Use of colors to stimulate movement

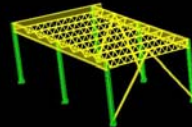
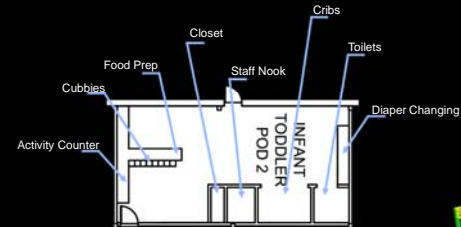


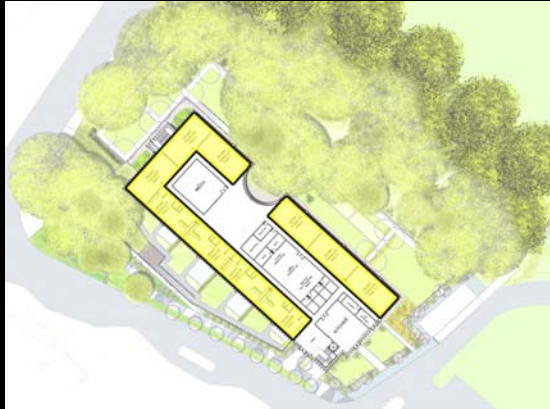


Infant Classroom



- Multiple height windows for child interaction.
- Support bar runs along corridor for easy coordination





Infant Classroom



Night Render

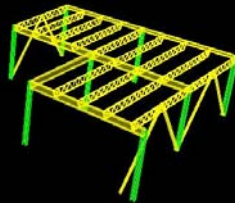
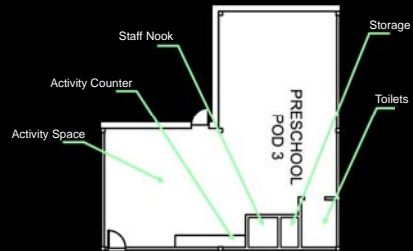
- Lighting Design
- Integration



Preschool Classroom



- Support bar
- Coved balcony space
- Interaction with sculptural screen





Rooftop Play Deck



Exterior Play Area

- Spaces were created by framing the view from interior of the building
- Integration
 - Materials
 - Planting Restriction
 - Flexibility

Pre-school Gathering Areas



Exterior Play Area

- Spaces were created by framing the view from interior of the building
- Integration
 - Materials
 - Planting Restriction
 - Flexibility
 - Maximizing Daylight



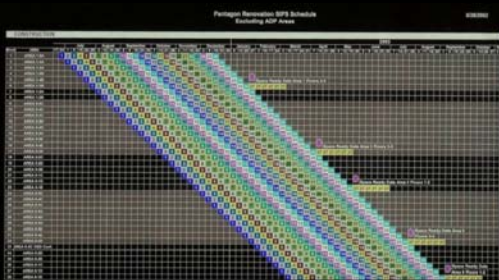
Toddler's Interaction with Hort Woods



Exterior Play Area

- Spaces were created by plantings and material changes
- Integration
 - Materials
 - Planting Restriction
 - Flexibility of each space

- Four main phases
- SIPS Schedule
 - Short Interval Production Schedule



Construction Sequencing



- Four main phases
- Erect both stories before moving to the next phase.
- Crane will operate in the building footprint.
- Crane & Other Trades work their way out of the building.

- Four Main Phases



Site Logistics Concerns

- Trees on Eastern side of the building.
- Trees on North-West corner by utilities.
- East Wall Construction
- Trailer Location
- Material Storage
- Emergency Conditions



- RS Means 2010
- Total SF = 24,096 SF
- Exterior Walls = Brick on Metal Stud
- Perimeter = 1271 Ft

Estimate

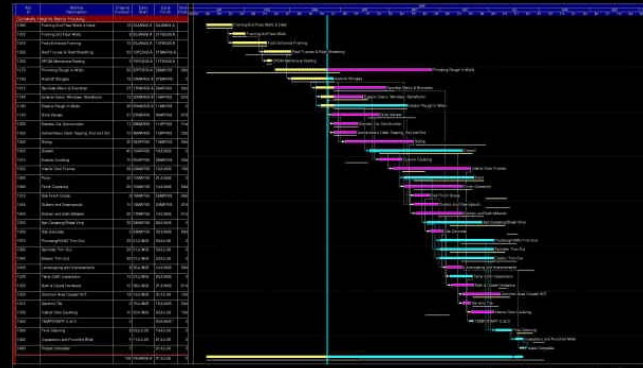
- Total Cost = \$7,324,683
- General Conditions = \$671,830
- Site Prep = \$139,155
- Core, Shell, Finishes = \$2,878,181
- Building Systems = \$3,298,173
- Hardscape & Landscape = \$337,344



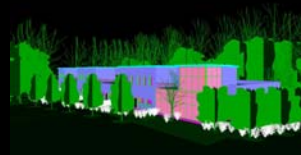
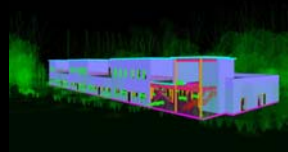
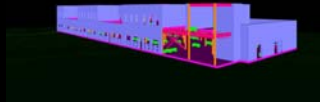
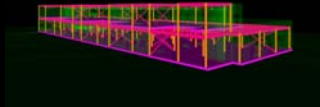
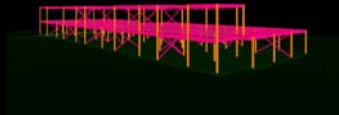
- Schedule Risks
 - Long Lead Items
 - Complex Exterior Decorative System
 - Complex Site Logistics Issues

Schedule

- Notice To Proceed = 2/12/2010
- Start Site Clearing = 2/15/2010
- Pour First Footings = 3/8/2010
- Begin Erect Steel Structure = 3/29/2010
- Complete Exterior Building Construction = 7/28/2010
- Complete Exterior Site Construction = 9/2/2010
- Project Substantial Completion = 11/28/2010



4D Schedule





Sustainable Construction

- Penn State LEED Policy
 - Significant Effort to maximize open space
 - Mandatory Stormwater Management Quality Control
 - Significant Effort for reducing the Heat Island Effect
 - Mandatory to divert 75% of Construction waste from disposal
 - Mandatory IAQ Management Plan
 - During Construction and Before Occupancy
 - Mandatory Low Emitting Materials (Low VOC)
 - Carpet, Paint, Adhesives, Coatings, Sealant, Wood
- Recycling Materials on Site
- Construction Activity Pollution Prevention
- Maximize Open Site Space
- Protect Site Habitat
- Stormwater Management
- Heat Island Effect



BIM Goals

- Increase effectiveness of design across disciplines
- Increase effectiveness of sustainable goals
- Utilize clash detection to find conflicts between systems
- Accurate 3D model record for owner
- Identify concerns with phasing on campus
- Review design process
- Quickly assess cost associated with design changes





Lessons Learned

- Working together from the beginning helps avoid problems down the road
- Rendering always takes longer than anticipated
- Taking the time to plan saves time later
- Revit might not be the best design tool for everyone, but it is good for integrating



Problems

- Sequence of events
 - Phasing (someone can't start until someone else finishes)
- Converting to Revit
- Clashes
- Leadership throughout project

Lessons Learned



Solutions

- Set deadlines so that everyone has enough time to work on their part
- Re-draw what's missing in Revit and change as necessary
- Use Navisworks to figure the clashes out and change in respective design programs as necessary
- Change Leader as phase of project changed

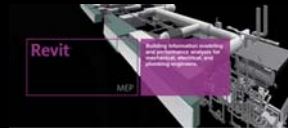
Dos Design Build



SAP 2000



BIM Program Usage





LEED Certification Analysis

Sustainable Sites	6/14
Water Efficiency	2/5
Energy and Atmosphere	14/17
Materials and Resources	7/13
Indoor Environmental Quality	12/15
Innovation and Design	5/5
Overall	46 points

LEED GOLD



DOS DESIGN BUILD

Questions?

	Dos Design Build			

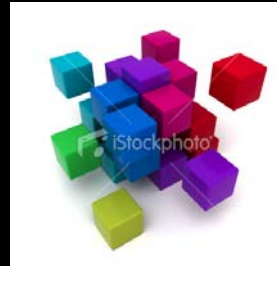
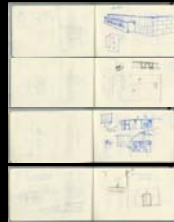
DOS DESIGN BUILD

Appendix

ARCHITECTURE

Design Themes

- Using basic forms and colors to create stimulating learning environments for children



ARCHITECTURE



Bambinos International Learning Center, Scott Edwards
Architecture
Photo Credit: archdaily.com



Children's Rec. Centre, AIR Architecture
Photo Credit: archdaily.com



Blob vb3, dmva
Photo Credit: archdaily.com

ARCHITECTURE



Wind Calculations

Location: State College, PA

Topography: Homogeneous

Dimensions: 80 x 220 x 29'

Framing: CMU Walls, Steel framing with glass, 20-ft spans

Cladding: Doors and glass sizes vary

No Roof Top Equipment

Basic Wind Speed: 90 MPH

Exposure B

Building Classification: Category II

Velocity Pressure:

$$q_z = 0.00256k_zk_{zt}k_dV^2I$$

$$k_z = 0.70 \text{ (Exposure B, 29')}$$

$$k_{zt} = 1.0$$

$$k_d = 0.85 \text{ for buildings}$$

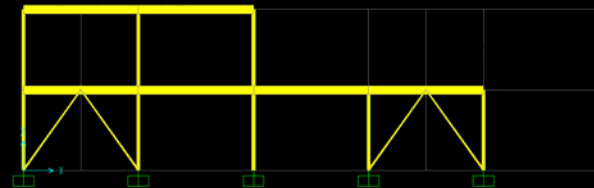
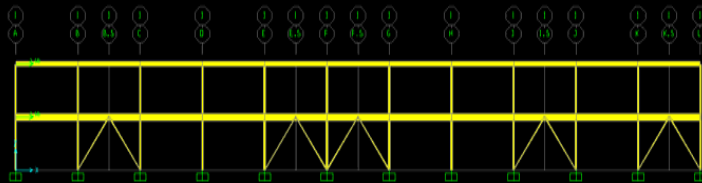
$$V = 90 \text{ MPH}$$

$$I = 1.0 \text{ (building category II)}$$

$$q_z = 0.00256(0.7)(0.85)(90^2) = 12.3 \text{ PSF}$$

Design by MWFRS

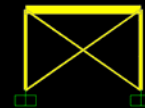
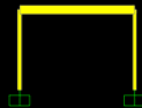
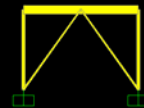
Appendix - Structural



$$K = 555.6 \text{ k/in}$$

$$K = 13.6 \text{ k/in}$$

$$K = 833.3 \text{ k/in}$$



Sample Joist Calculation:

Dead Load: 285 PLF (Includes SDL, Self Weight, Slab)

Live Load: 160 PLF

Wind Load: 175 PLF

Controlling Load Case: $1.2D + 0.5L + 1.6W \rightarrow W_{u,TL} = 702 \text{ PLF}$

Look in Catalog \rightarrow Choose 20K7



Appendix - Structural

Sample Column Calculation:

AT = 400 SF

$$LL_{red} = 0.25 + \frac{15}{\sqrt{4(400)}} = 0.625$$

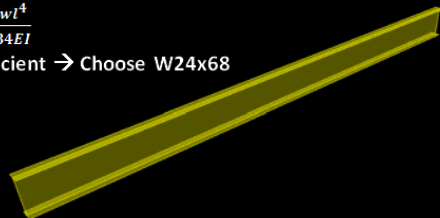
- $P_D = 50(400) + 265(400) = 126k$
- $P_S = 24.5(400) = 10k$
- $P_L = 100(0.625)(400) = 24k$
- $P_u = 196k$
- Try W8x31
 - $\phi P_n = 265k$
 - Choose W8x31



Sample Beam Calculation:

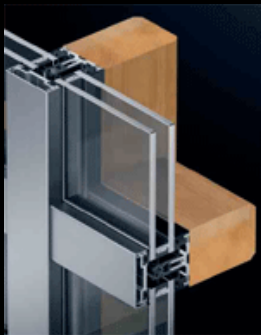
$W_u = 730 \text{ PLF}$

- $V_u = 73k$
- $M_u = 438\text{ft-k}$
- Try W18x76
 - $\phi M_p = 611\text{ft-k}$
 - $\phi V_n = 155k$
- Check Deflection
 - $\Delta \leq 1'' = \frac{5wl^4}{384EI}$
 - I not sufficient \rightarrow Choose W24x68

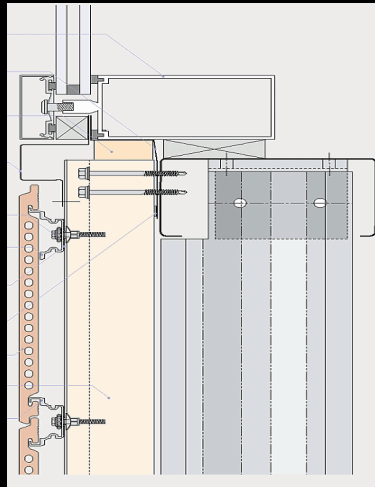


Appendix - Structural

Curtainwall: Schuco FW60+ AOT



Curtainwall



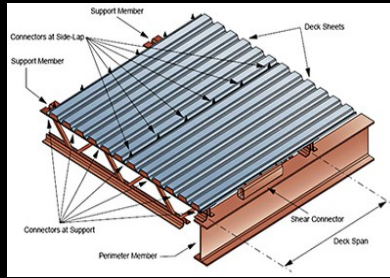
Appendix - Structural

Floor Systems

1ST FLOOR

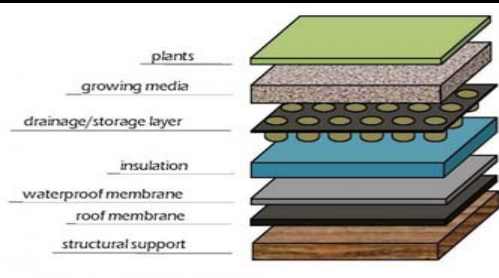


2ND FLOOR



Ceiling and Roof Systems

Green Roof



Fan Coil + Radiant Floor																	
Electric													kwh/yr	Saving			
On-Pk Cons. (kWh)	8,822	7,972	8,931	25,303	28,459	26,562	28,410	27,383	27,563	26,348	8,183	8,609	232,545	10,209			
On-Pk Demand (kW)	29	28	28	63	67	75	78	78	69	63	28	28	78				
Gas																	
On-Pk Cons. (therms)	670	608	339	50	0	0	0	0	0	55	120	473	2,315				
On-Pk Demand (therms/yr)	3	3	3	1	0	0	0	0	0	1	3	3	3				
Water	Environmental	Building	17,643											1,107 gr NOX			
Water																	
													Btu/(t2 CO2	439,739 Source	*****	Btu/(t2 SO2	
Cost electricity	666	605	674	1891	2122	1994	2131	2056	2060	1966	620	651	17434				
Cost gas	708	642	358	52	0	0	0	0	0	58	127	500	2445				
Cost Total	1374	1247	1032	1943	2122	1994	2131	2056	2060	2024	745	1150	19879				
Baseline																	
Electric													kwh/yr				
On-Pk Cons. (kWh)	9,575	8,781	10,622	14,105	22,677	24,755	28,854	26,126	23,435	16,159	10,659	9,520	205,268	9,0109			
On-Pk Demand (kW)	40	40	41	55	64	73	80	73	66	56	42	40	80				
Gas																	
On-Pk Cons. (therms)	1,130	978	396	1,101	735	800	773	905	772	1,216	203	834	9,873				
On-Pk Demand (therms/yr)	9	9	7	5	2	2	2	2	2	5	6	8	8				
Water																	
	1	1	3	23	55	80	106	87	60	29	3	1					
	Environmental	Building	39,721	Btu/(t2 CO2	853,683 Source	*****	Btu/(t2 SO2	2,493 gr NOX									
Cost electricity	733	676	809	1075	1703	1862	2164	1960	1760	1225	813	729	15509				
Cost gas	1193	1033	418	1163	776	877	817	956	816	1284	214	880	10427				
Cost Total	1926	1709	1227	2238	2479	2738	2981	2916	2575	2509	1027	1610	25936	6056			

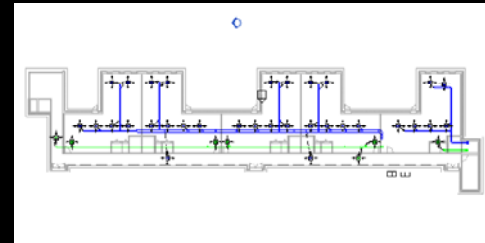
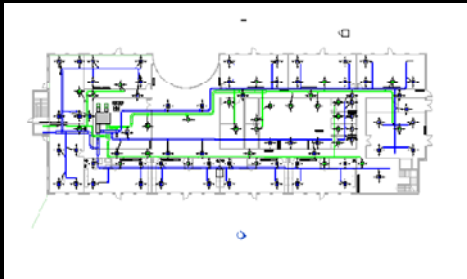
Building Type	Fossil Fuel, Fossil/Electric Hybrid, and Purchased Heat	Electric and Other
Residential	System 1—PTAC	System 2—PTHP
Nonresidential and 3 Floors or Less and <25,000 ft ²	System 3—PSZ-AC	System 4—PSZ-HP
Nonresidential and 4 or 5 Floors and <25,000 ft ² or 5 Floors or Less and 25,000 ft ² to 150,000 ft ²	System 5—Packaged VAV with Reheat	System 6—Packaged VAV with PFP Boxes
Nonresidential and More than 5 Floors or >150,000 ft ²	System 7—VAV with Reheat	System 8—VAV with PFP Boxes

Notes:
 Residential building types include dormitory, hotel, motel, and multifamily. Residential space types include guest rooms, living quarters, private living space, and sleeping quarters. Other building and space types are considered nonresidential.
 Where no heating system is to be provided or no heating energy source is specified, use the "Electric and Other" heating source classification.
 Where attributes make a building eligible for more than one baseline system type, use the predominant condition to determine the system type for the entire building.
 For laboratory spaces with a minimum of 3000 cfm of exhaust, use system type 5 or 7 and reduce the exhaust and makeup air volume to 30% of design values during unoccupied periods.
 For all-electric buildings, the heating shall be electric resistance.

System No.	System Type	Fan Control	Cooling Type	Heating Type
1. PTAC	Packaged terminal air conditioner	Constant volume	Direct expansion	Hot-water fossil fuel boiler
2. PTHP	Packaged terminal heat pump	Constant volume	Direct expansion	Electric heat pump
3. PSZ-AC	Packaged rooftop air conditioner	Constant volume	Direct expansion	Fossil fuel furnace

Integrated System :
DOAS+ Fan Coil (cooling) + Radiant Floor (heating)
0.87 \$/sf

Appendix – Mechanical



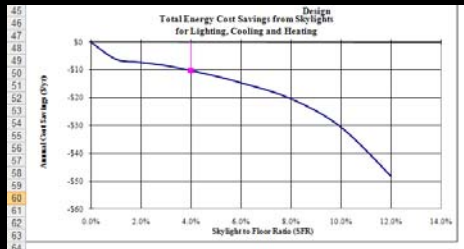
Daylight in Relation to the Site

- Southern façade open for maximum light penetration.
- Late day sun is blocked.
- Favorable weather for skylights and light wells.
- Early morning sun for prime school hours.



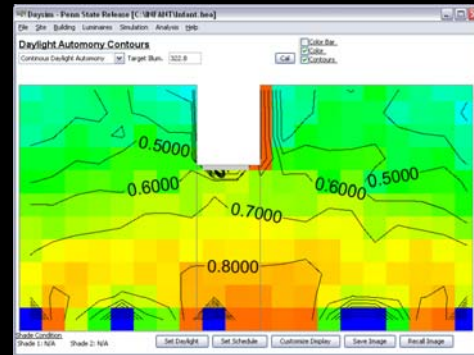
Appendix – Daylighting

Preschool Skylight Analysis



Skylights may add light but will also add long-term cost – Room too deep for traditional daylight

Infant Daylight Analysis - Southern Façade

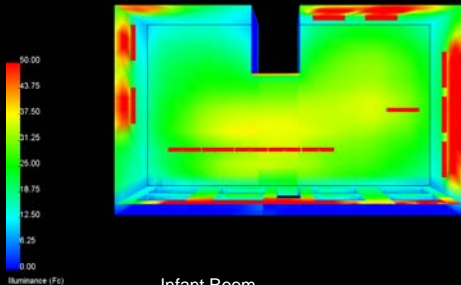


Appendix – Lighting

- Home-Like Environment
- Safety of Children
- Optimize Controls
- Indirect Lighting
- Lighting Power Density
- Illuminance ~ 30 fc
- Keep maintenance to a minimum



Resulting Average Illuminance
Preschool: 31.2 fc
Infant: 34.2 fc



Infant Room



Preschool room



Tree Up-Light:
Metal Halide Narrow
Beam Spotlight

Appendix - Site Lighting

- Design Scenarios
 - Outdoor Scenery
 - Nighttime Activities
 - Safety
- Techniques
 - Grazing
 - Up-lighting
 - Flood Lighting



Playground Ambient:
Metal Halide Wide
Spread Spotlight



Fence Grazing:
LED Color Changing Strip



Brick Grazing:
In-ground Metal Halide
Wide Beam Spread